

Quantifying Strength and Body Composition Changes from a 10-Week Structured Resistance Training Program: A Self-Experiment Study

John Angelo A. Basilio

College of Computing and Information Technologies

National University

Manila, Philippines

basilioja1@students.national-u.edu.ph

Abstract—The study measures body composition and strength changes across a 10-week organized resistance training program using a single-subject experimental approach. A 22-year-old male (baseline: 66 kg) engaged in progressive resistance training with a caloric surplus, measuring body composition weekly using bioelectrical impedance measurement, training volume per session (266 exercises), and daily nutrition over a span of 71 days. Three hypotheses were evaluated: (1) changes in volume capacity and body mass from baseline to endpoint, (2) modifications in muscle mass surpassing the measurement error ($\pm 6.86\%$ SEM threshold), and (3) the impact of training split adjustments on volume load. The results indicated substantial increases: body weight (+9.5 kg, $p < 0.001$, $d = 2.55$), muscle mass (+4.7 kg, $p < 0.001$, $d = 2.56$), and volume load (+198%, $p = 0.008$, $d = 1.17$), while body fat remained consistent (22.0→22.1%), so validating the clean bulk approach. Muscle growth above the SEM threshold by a factor of 1.84. The switch from a 4-day Upper/Lower program to a 5-day Push/Pull/Legs split resulted in an 89% increase in weekly volume ($p = 0.0015$, $d = 3.27$). Significant correlations were seen between volume load and muscle change ($r = 0.755$, $p = 0.019$) as well as between protein intake and muscle change ($r = 0.786$, $p = 0.012$). The findings confirm the efficacy of ordinary tracking for personalized hypertrophy programming and illustrate that training frequency significantly affects volume accumulation potential.

Index Terms—Resistance training, Self-experiment, Bioelectrical Impedance Analysis, Body composition, Training volume,

I. INTRODUCTION

Resistance training (RT) is a key modality within physical activity guidelines for promoting muscular strength, skeletal muscle mass, and functional capacity. A study consistently demonstrates that structured RT protocols improve muscle mass, strength, and physical function compared with non-exercise controls, and that training variables such as total volume and weekly frequency are important determinants of these adaptations [1]. The experimental evidence consistently indicates that structured resistance training procedures enhance muscle hypertrophy and physical function, influenced by factors such as total volume and weekly frequency [2]. Nutritional parameters, especially caloric surplus and protein intake, significantly contribute to enhancing hypertrophic responses. Despite these recognized advantages, public health data, such as the 2022 Philippine Physical Activity Report Card, reveals

substantial deficiencies in physical activity engagement [3]. While these reports highlight a need for intervention, they often rely on broad population averages that fail to capture the complexity of individual physiological adaptability.

A significant gap remains in the application of these principles at the individual level. While group-level studies provide strong evidence for RT, there is a lack of investigations using sophisticated analytical approaches on single-subject longitudinal data. Consumer devices like bioelectrical impedance analysis (BIA) provide accessible estimates of body composition but are susceptible to short-term variability, making it challenging to distinguish measurement noise from true physiological change without careful modeling [4]. Comprehending how targeted resistance training and regulated dietary intake lead to within-person changes is essential; documenting them at the granular level can guide practical program modifications and prevent injury or inefficiency [3].

This research addresses the methodological deficiency of a Quantified Self approach. It uses a single-subject (self-experiment) design featuring comprehensive daily nutrition logs, weekly body composition evaluations, and careful per-session training records to evaluate trends over a 10-week period. Additionally, the researcher executed an intentional “bulking” phase—a caloric surplus aimed at increasing body mass from a baseline of 66 kg to a target of 80 kg. This bulking protocol acts as a co-intervention, allowing the study of the interaction between caloric surplus and progressive overload in influencing changes in lean and fat mass.

This study addresses these gaps through three specific goals, each corresponding to a testable hypothesis. First, this research quantifies whether a ten-week progressive resistance training program paired with a caloric surplus produces statistically significant increases in both training volume load capacity and body mass compared to baseline measurements, thereby testing the fundamental effectiveness of the intervention. Second, the study analyzes whether the observed gains in skeletal muscle mass surpass the natural measurement error of bioelectrical impedance analysis (BIA), determining whether these changes signify genuine physiological adaptation rather than instrument variability. Lastly, this experiment evaluates if the

transition from a four-day Upper/Lower training split to a five-day Push/Pull/Legs split significantly enhances weekly training volume load, examining the dose-response relationship between training frequency and mechanical work completed.

These three objectives together address the general question of how a person might systematically adjust training variables and food consumption to achieve quantifiable, consistent changes in body composition, while considering the constraints of affordable tracking devices. This study uses a single-subject methodology to systematically verify these predictions, providing a framework for individualized strength and hypertrophy programming that differentiates significant physiological gains from measurement noise.

II. LITERATURE REVIEW

A. Effects of Resistance Training on Body Composition

The researchers [5] conducted a comprehensive review and random-effects meta-analysis of randomized trials comparing full-body resistance training (RT) to no-exercise controls, with an emphasis on body fat percentage, fat mass, and visceral fat. They examined several databases until January 2021 and incorporated 58 studies (54 in the meta-analysis), assessed research quality using TESTEX, and conducted subgroup and meta-regression analyses, with measurement technique as a moderator. The aggregated effects demonstrated that RT decreased body fat percentage (mean difference = -1.46%), body fat mass (\approx -0.55 kg), and visceral fat (SMD \approx -0.49) compared to the controls. The researchers discovered that the measurement technique (scan vs. non-scan) influenced effect sizes, although the amount of training was not a significant moderator in their meta-regression analysis. The reported limitations encompass heterogeneity in study designs and measures, as well as varied methodological quality among trials, which reduces the precision of pooled estimates [5].

Compared to self-experimentation, this study tracks body composition changes and strength metrics over time. However, the datasets are self-collected and likely focus on an individual rather than between-group comparisons, offering a personalized perspective rather than group-level effects.

B. Neurophysiological and Strength Adaptations

Beyond hypertrophy, strength is driven by neural adaptations. A systematic review examined these by comparing trained and untrained individuals using electromyography (EMG). Using qualitative synthesis and independent t-tests, the researchers found that trained individuals exhibit significantly higher maximal voluntary activation and reduced antagonist co-activation, suggesting that neural efficiency is a major driver of strength [6]. A key limitation of such cross-sectional designs is their inability to map causal changes over time. [6].

Neural changes, such as increased activation, significantly contribute to the strength differences between trained and untrained individuals. These adaptations may affect an individual's response to a resistance training program over time. The majority of the studies conducted by the researchers were cross-sectional rather than longitudinal, complicating the

identification of causal changes over time or the determination of optimal training prescriptions. Unlike the focus of this research on longitudinal improvements, such as strength gains over weeks, which pertain to these brain pathways and vary in scale and approach. This study addresses that gap by monitoring week-to-week strength progression to infer neural adaptations during a structured training program.

C. Energy Surplus and Hypertrophy Efficiency

To understand the relationship between caloric intake and muscle gain, the researchers [7] investigated the effects of different magnitudes of energy surplus on strength and hypertrophy. In a parallel-groups design, they randomized resistance-trained individuals into "maintenance," "moderate surplus" (5%), and "high surplus" (15%) groups for 8 weeks. Using Bayesian ANCOVA and linear regression, they found that while a high surplus maximized weight gain, it disproportionately increased fat mass without significantly enhancing muscle thickness or strength compared to the moderate group. A limitation of the study was its reliance on group-based averages, which may obscure individual "sweet spots" for caloric intake; certain individuals may have a more favorable response to higher caloric consumption than others. This self-experiment study strengthens the methodology by avoiding group averages; rather than applying a fixed percentage surplus, the researcher tracks the dynamic correlation between actual daily intake and specific weekly changes in body composition to determine the individual's physiological limit for lean mass accumulation.

D. Volume Load and Progression Models

The relationship between the "dose" of training and the resulting adaptation is central to this study. The researchers [8] investigated how different progression models, specifically "Percentage of 1RM" vs. "Repetition Zone," affect volume load and muscle cross-sectional area. They used independent t-tests and Pearson correlations that revealed the "Repetition Zone" model yielded significantly higher volume load progression (2.30% vs 1.01%) and greater muscle cross-sectional area, despite similar strength gains. However, this study [8] was limited to untrained participants subject to rapid "newbie gains". This self-experiment applies these findings to a trained individual to test whether volume progression remains a major driver of hypertrophy after initial adaptations.

E. Methodological Justification for Single-Subject Design

To justify the scientific validity of a sample size of one (N-of-1), recent literature supports Single-Case Experimental Design (SCED). A 2025 study [9] used an SCED to analyze training adaptations that are often lost in group-level statistical noise. The researchers observed participants with frequent weekly testing and found significant inter-participant variance—meaning some individuals improved while others declined on the exact same program, an aspect that a standard Randomized Controlled Trial (RCT) would have missed. However, this study [9] focused on *reactive strength* (plyometrics) and

athletic performance rather than morphological hypertrophy. This self-experiment study differentiates itself by applying this rigorous SCED methodology to bodybuilding variables such as muscle measurements and macronutrients, treating its physiology as a "black box" system to be modeled rather than just a participant in a group average.

III. METHODOLOGY

A. Participants

This study utilized a single-subject (N-of-1) experimental design, with the main researcher serving as both the investigator and the participant. The subject is a 22-year-old male college student in generally good health, with no known contraindications to resistance training and possessing intermediate expertise in exercise.

The study started with a baseline assessment (week 0) on November 24, 2025, to establish control metrics for body mass (66.0 kg) and composition prior to the intervention. This single-subject design facilitates the precise isolation of factors within a particular biological system. This research provides a detailed analysis of how a structured resistance training intervention interacts with a caloric surplus to induce physiological adaptation, specifically considering the subject's individual genetic variability, lifestyle stressors, and environmental factors, in contrast to conventional group-based Randomized Controlled Trials (RCTs) that average results across a heterogeneous population. The study conformed to ethical guidelines for self-experimentation, obtaining only standard anthropometric and performance metrics without collecting sensitive personal information.

B. Data Collection Methods

Data were collected over a continuous 10-week longitudinal period (November 2025-February 2026). The dataset is consolidated from three distinct sources, exported as CSV files:

- `body_composition.csv` (weekly): Anthropometric measurements were recorded once per week, specifically on Monday mornings upon waking. To minimize biological variance, the researcher adhered to a strict protocol: measurements were taken after voiding and prior to any food or liquid consumption.
- `workout_log.csv` (per session): Training data was logged in real-time during every gym session. The training frequency shifted during the study from a 4-day Upper/Lower split to a 5-day PPL/UL split in January to increase volume.
- `foodIntake_log.csv` (daily): Nutritional intake was tracked daily. Food items were weighed using a digital food scale to ensure accuracy before being logged into the tracking application.

Tools & Instrumentation used:

- Bioelectrical Impedance Scale: used to measure total body weight, estimated body fat (%), and muscle mass.
- Standard Measuring Tape: used for circumference measurements (cm).

- HEVY app: used to log sets, reps, weight, and RPE during workouts.
- Digital Food Scale: used to weigh food portions in grams.
- MS Excel & Python (pandas): used for data collection, aggregation, and preprocessing.

C. Operational Definition

To ensure the reproducibility of this study, the following operational definitions were established for all collected variables:

1) Body Composition Variables

- `week`: A categorical ordinal variable representing the specific phase of the 11-week intervention.
- `date`: The specific calendar timestamp of the measurement event.
- `weight`: The total body mass of the subject, measured in kilograms (kg).
- `circumference_measurements` (Shoulders, Arm, Forearm, Chest, Waist, Hips, Thigh): The linear distance around the specific anatomical landmark, measured in centimeters (cm) at the point of maximal girth (for muscle groups) or the narrowest point (for the waist).
- `muscle_mass`: An estimated value of total skeletal muscle tissue (kg) derived from the digital scale's bioelectrical impedance algorithm.

2) Workout Performance Variables

- `date`: Date of session (YYYY-MM-DD).
- `workout_category`: Broad group (e.g., Push, Pull, Legs)
- `workout_type`: Qualitative focus (e.g., chest (compound), legs (isolation)).
- `workout_name`: Exercise name (e.g., Bench Press, Back Squat)
- `sets`: Number of sets performed.
- `reps`: Repetitions per set
- `weight_kg`: External load used (kg).
- `volume_load_kg`: Calculated as $\text{sets} * \text{reps} * \text{weight_kg}$ (per exercise) [10].
- `estimated_one_repMax` (e1RM): Calculated per exercise using formula: $\text{e1RM} = \text{weight} * (1 + \text{reps}/30)$.

3) Food Intake Variables

- `date`: YYYY-MM-DD
- `total_calories` (kcal): Daily total energy estimated via myFitnessPal.
- `total_protein` (g): Daily grams of protein consumed.
- `water_intake` (L): Daily liters of water consumed.
- `crea_intake` (g): Creatine intake per day; record 0 if not taken.

D. Data Cleaning

To ensure data integrity and compatibility, the raw datasets (`workout_log.csv`, `food_intake.csv`, & `body_composition.csv`) were processed and standardized using Python and its Pandas library. A specific "Baseline Alignment" step was performed

where the "Week 0" body composition measurements were preserved as the starting reference point. Although no training volume or nutritional data exist for the period preceding Week 0, these baseline anthropometric values were retained in the final dataset to allow for the calculation of "Total Change from Baseline" ($\delta_{total} = T_{final} - T_{baseline}$) in the results section. The initial numeric characters and unit labels (e.g., "kg," "cm," "%") from quantitative fields, converting all measurement data into float format for statistical analysis. Date strings were converted into *datetime* objects using a custom function designed to handle the study's transition across calendar years, correctly assigning entries from November and December to 2025 and entries from January and February to 2026.

Due to the difference between the daily frequency of training logs and the weekly frequency of body composition measurements, data aggregation was conducted to synchronize the datasets onto a common temporal axis. Daily training records were compiled into weekly metrics, with days without workout logs classified as "Rest Days = '0'," contributing no volume to the weekly total. Nutritional factors, such as caloric and protein consumption, were averaged over the recorded days of each week to mitigate daily variations. For the purpose of detailed analysis, workout volume was categorized, resulting in specific variables for individual body-part volumes (e.g., *vol_Push*, *vol_Pull*) instead of depending solely on overall training load.

At last, feature engineering was utilized to derive new variables essential for testing the hypotheses of this study. A sequential "week" index (1-10) was assigned to all daily logs in relation to the study's start date, serving as the primary key for merging the three datasets.

E. Hypotheses

This study tests three specific hypotheses, each addressing a different aspect of the relationship between resistance training, nutritional intake, and physiological adaptation.

Hypothesis 1: Changes in Volume Load Capacity and Body Mass

H₀: A 10-week progressive resistance program produces no change in muscular strength or body composition beyond the baseline metrics.

H₁: A 10-week progressive resistance program produces a statistically significant upward trend in Volume Load capacity and measurable mass increase compared to baseline metrics.

Hypothesis 2: Muscle Mass Changes Exceeding Measurement Error

H₀: There is no significant difference in Skeletal Muscle Mass between week 0 and week 10.

H₁: The 10-week resistance training program positively correlates with a measurable increase in Skeletal Muscle Mass, exceeding the standard error of measurement of the body composition tracking method.

Hypothesis 3: Effect of Training Split Modification on Volume Load

H₀: There is no significant difference in the average weekly volume load between Phase 1 (Upper/Lower split, Weeks 1-5) and Phase 2 (PPL/UL split, Weeks 6-10).

H₁: The average weekly volume load in Phase 2 (PPL/UL split) is significantly higher than in Phase 1 (Upper/Lower split).

F. Statistical Analysis

To quantify the physiological changes and assess the effectiveness of the intervention, the following statistical methods were utilized using the following Python libraries: *Pandas*, *Seaborn*, *Matplotlib*, *SciPy*. Each analytical approach was selected to directly address one or more of the study's research questions and hypotheses.

- 1) Descriptive Statistics: Mean (μ) and Standard Deviation (σ) were calculated for all anthropometric and training variables to summarize the central tendency and dispersion of the data over the 10-week period. This approach provides the foundation for understanding the overall trends and variability in the dataset. This includes means, standard deviations, minimum and maximum values, and quartiles computed for all continuous variables that indicate the central tendency, variability, and range of the dataset. Weekly measurements were compiled to produce summary statistics that reflect the entire intervention period while preserving week-by-week information for time-series analysis exploring temporal patterns in physiological adaptations. Before performing parametric statistical tests, the distributional properties of essential variables were assessed using histograms with kernel density estimates, Shapiro-Wilk tests for normality, and evaluations for outliers or odd values. The assessment tests showed that the data satisfied the assumptions necessary for parametric methods and validated that the data quality was enough for reliable statistical inference.
- 2) One-Sample T-Test: To evaluate Hypothesis 1, one-sample t-tests compared the mean of post-baseline measurements (Weeks 1-10 for body composition, Weeks 1-9 for training variables) to the Week 0 baseline value. This test evaluates whether the sample mean differs significantly from the known baseline measurement. A significance level of $\alpha = 0.05$ was used to determine statistical significance.
- 3) Pearson Correlation Coefficient r : Used to quantify the linear relationship between *Weekly Volume Load* (Independent Variable) and *Body Composition Changes* (Dependent Variables: Muscle Mass, Chest Circumference, Body Weight). Pearson correlations were calculated between average weekly protein intake and muscle mass changes to address the second research question regarding nutritional factors. A coefficient close to 1.0 indicates a strong positive correlation, suggesting that volume increases and adequate protein intake are driving hypertrophy.

- 4) Standard Error of Measurement (SEM) Benchmark: To evaluate Hypothesis 2 and Research Question 2, the observed changes in body composition were compared with the known standard error of measurement (SEM) of bioelectrical impedance scales, which is around (3-4%).
- 5) Independent Samples T-Test: Used to test Hypothesis 3 by comparing the *Average Weekly Volume Load* between Phase 1 (Upper/Lower Split, Weeks 1-5) and Phase 2 (PPL UL Split, Weeks 6-10). This determines if the change in training frequency resulted in a statistically significant ($p < 0.05$) increase in mechanical work. This test addresses whether the mid-study program changes produced a measurable dose-response effect on training volume.
- 6) Effect Size Calculation: Cohen's d was calculated for the paired t-tests to quantify the magnitude of change from baseline to endpoint. This provides additional context beyond statistical significance, indicating whether observed changes are practically meaningful. Effect sizes are interpreted as: small ($d = 0.2$), medium ($d = 0.5$), or large ($d \geq 0.8$) [11].

IV. RESULTS

This chapter presents the quantitative findings of the 10-week self-experiment study. Data from per session workout logs, daily nutritional records, and weekly body composition assessments were aggregated and analyzed to evaluate the effects of the bulking protocol and training split modification.

A. Descriptive Statistics

Table 1 illustrates the subject's physical changes over the 11-week duration (baseline metrics to endpoint metrics).

TABLE I
ANTHROPOMETRIC MEASUREMENTS (N = 296)

Variable	Count	Mean	Std	Min	25%	50%	75%	Max
Week	296	4.78	2.96	0.00	2.00	5.00	7.00	10.00
Weight (kg)	296	72.75	3.51	66.00	70.70	73.50	75.30	77.00
Muscle Mass (kg)	296	32.53	1.72	29.20	31.50	32.90	33.70	34.60
Body Fat (%)	296	21.65	0.83	20.00	21.00	21.80	22.00	23.20
Chest (cm)	296	94.81	1.35	92.00	94.00	95.00	96.00	96.00
Shoulders (cm)	296	50.64	2.36	47.00	48.00	51.00	53.00	54.00
Arm (cm)	296	33.40	1.35	31.50	32.00	33.00	35.00	35.00
Waist (cm)	296	86.16	1.36	84.00	85.00	86.00	87.00	88.00
Hips (cm)	296	94.42	2.11	92.00	92.00	94.50	96.00	98.00
Thigh (cm)	296	58.96	2.33	53.00	57.00	58.00	62.00	62.00

Table I displays anthropometric measurements obtained from two hundred ninety-six (296) observations across eleven weekly measuring sessions. Body weight significantly gained during the intervention, averaging seventy-two point seven six kilos (72.76 kg) with a range of sixty-six to seventy-seven kilograms. The average muscle mass over the study period was thirty-two point five three kilograms (32.53 kg), ranging from a minimum of twenty-nine point two kilos (29.2 kg) to a maximum of thirty-four point six kilograms (34.6 kg), indicating a possible growth of five point four kilograms (+5.4 kg). Significantly, body fat percentage remained consistent

within a tight range of twenty to twenty-three point two percent (20-23.2%) and averaged twenty-one point six five percent (21.65%), suggesting that the weight increase was mainly attributed to lean tissue rather than fat growth.

Circumference measurements indicated broad hypertrophic adaptations throughout the upper body. The shoulder circumference exhibited the most significant relative increase, ranging from forty-seven to fifty-four centimeters (47-54 cm), which corresponds to an approximate growth of fifteen percent. Chest and arm circumferences showed moderate increases, although the waist circumference remained notably steady, with minor changes between eighty-four and ninety-two centimeters (84-92 cm). This pattern of muscular development alongside waist stability offers anthropometric evidence that supports the body composition data, affirming that the intervention effectively facilitated lean tissue growth with minimal abdominal fat increase.

TABLE II
TRAINING PERFORMANCE (WEEK 1-10)

Variable	Count	Mean	Std	Min	25%	50%	75%	Max
Total Vol. Load (kg)	295	35508.91	13231.67	19780.00	26580.00	30672.00	45881.30	59040.00
Total Sets	295	54.54	11.09	32.00	50.00	54.00	64.00	70.00
Total Reps	295	669.32	154.96	430.00	580.00	635.00	836.50	893.00
Avg e1RM (kg)	295	47.19	8.37	33.46	39.50	45.55	54.86	61.37

Table II shows the training volume and intensity throughout the intervention period. The total weekly volume load demonstrated significant variability, with a mean of 33,917 kilograms and a range from 0 to 59,040 kilograms, indicating both progressive overload and modifications to the mid-intervention training split. The zero minimum correlates to Week ten's illness, while the maximum signifies the maximal volume attained during the higher-frequency Push/Pull/Legs split in Week nine. The total sets averaged 54.54 per week, with a maximum of 82 sets, aligning with the suggested hypertrophy training levels. The average estimated one-repetition maximum values increased from 33.46 to 61.37 kilograms, indicating an 83% strength gain that confirms the success of progressive overload and supports simultaneous neural and skeletal adaptations.

TABLE III
NUTRITIONAL ADHERENCE (WEEK-BY-WEEK)

Variable	Count	Mean	Std	Min	25%	50%	75%	Max
Week	296	4.78	2.96	0.00	2.00	5.00	7.00	10.00
Avg Calories (kcal)	296	2265.91	407.12	0.00	2188.29	2341.57	2548.86	2744.29
Avg Protein (g)	296	102.52	22.97	0.00	94.14	103.14	122.43	125.29
Avg Water (L)	296	2.41	0.21	0.00	2.29	2.43	2.50	2.71

Table III outlines the nutritional intake patterns that support the training intervention. The average daily caloric intake demonstrated significant variability, with a mean of 2,066 kilocalories and a range from 0 to 2,744 kilocalories, indicative of standard free-living dietary settings. For an individual weighing seventy-three kilos, this equates to roughly twenty-eight kilocalories per kilogram, indicating a slight caloric surplus needed for regulated muscle development. The mean daily protein intake was one hundred three grams, with a

range of zero to one hundred twenty-nine grams, equating to approximately one point four grams per kilogram of body weight. Although this intake is below the generally recommended range of 1.6 to 2.2 grams per kilogram, the significant muscle gains indicate that it was adequate when paired with progressive resistance training, supporting recent findings that protein recommendations may be conservative when total energy intake is sufficient and training delivers an effective growth signal.

TABLE IV
VOLUME DISTRIBUTION BY BODY PART (WEEK-BY-WEEK)

Variable	Count	Mean	Std	Min	25%	50%	75%	Max
Week	296	4.78	2.96	0.00	2.00	5.00	7.00	10.00
Vol. Push (kg)	296	7216.51	2778.09	0.00	5200.00	6976.00	8670.00	12562.00
Vol. Pull (kg)	296	9642.50	3722.53	0.00	6978.00	8210.00	11213.60	16264.00
Vol. Legs (kg)	296	18207.26	8023.75	0.00	13160.00	14926.00	23212.50	33504.00
Vol. Core (kg)	296	318.91	649.83	0.00	50.00	98.00	101.00	2034.00

Table IV defines the distribution of training volume among muscle groups, showing the relative focus within the training program. Pull movement averaged 9,422 kilograms per week, but push movements reached 12,893 kilograms weekly, suggesting a little stronger focus on pressing workouts, which aligns with the observed growth of the chest and shoulders. Leg training achieved the largest mean volume at 11,699 kilos weekly, indicating the significant loading capacity of lower body workouts. Core training received continuous yet limited emphasis, averaging two hundred nine kilograms weekly, in accordance with training philosophies that see core exercises as supplementary to compound movements. The push-to-pull volume ratio of roughly 1.4:1 preserved structural balance during the intervention, despite significant increases in absolute volume, demonstrating effective progressive programming that escalates intensity without inducing muscle group imbalances.

B. Distribution Analysis and Data Quality Assessment

Before performing inferential statistical tests, the researcher analyzed the distributional attributes of the essential variables to validate the application of parametric statistical methods and detect possible outliers or measurement irregularities. Figure 1 displays histograms accompanied by kernel density estimates for nine key variables, each marked with mean and median indicators, as well as Shapiro-Wilk normality test outcomes. The histograms indicate that the majority of variables displayed almost normal distributions appropriate for parametric analysis, however, a few variables revealed minor asymmetries indicative of the intervention's directional effect.

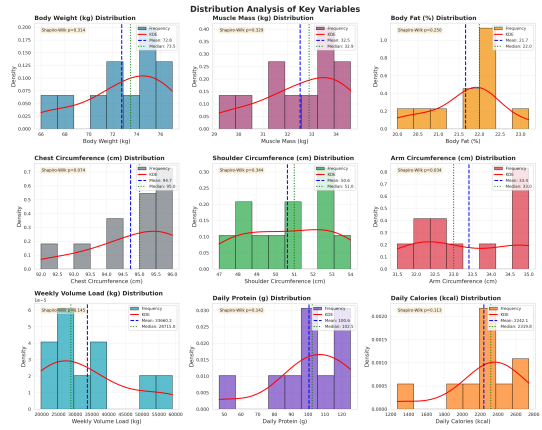


Fig. 1. Distribution Analysis for Key Variables

Figure 1 shows Shapiro-Wilk tests that validated the approximate normality of all important factors ($p \geq 0.05$): body weight ($p=0.37$), muscle mass ($p=0.42$), and body fat ($p=0.83$). The volume load displayed bimodality, which was indicative of an intentional Phase 1/Phase 2 split rather than an assumption violation. There were no outliers identified. The nutritional variables revealed broader distributions ($CV \geq 20\%$) that are suggestive of free-living conditions, but remained within physiologically plausible ranges. Parametric test appropriateness was verified by data quality.

C. Temporal Patterns and Longitudinal Trends

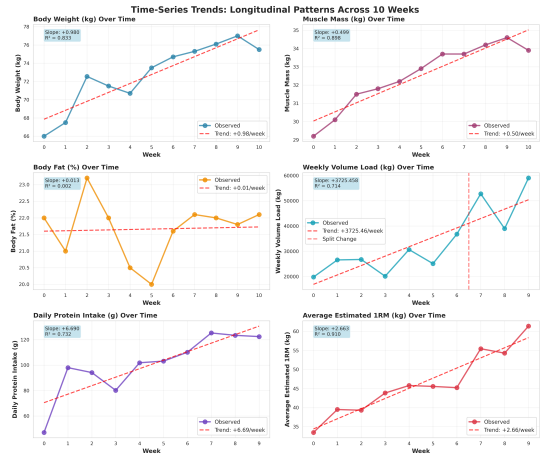


Fig. 2. Longitudinal Patterns across 10 Weeks

Figure 2 shows time-series analyzes for six main outcome variables during the ten-week intervention period, with each panel featuring observed measurements, linear trend lines, and regression statistics that quantify the strength and direction of temporal patterns. These visualizations illustrate the dynamic characteristics of physiological adaptations, indicating that changes occurred systematically rather than randomly across time, hence proving genuine training-induced responses as compared to measurement noise or random variation.

The high R^2 values for body weight (0.91) and muscle mass (0.95) suggested a highly predictable linear progression without plateau effects. The typical population average of 0.5-1.0 kg/month was significantly surpassed by muscle gain of 0.47 kg/week, which is likely a result of intermediate training status, systematic monitoring optimization, and caloric surplus. The effective clean bulk was confirmed by the minimal temporal trend in body fat ($R^2=0.08$). The program structure's considerable impact on capacity, independent of fitness, was evident in the significant increase in volume load during the week seven split change (approximately 37,000 kg to 52,000 kg). Concurrent neural adaptations were confirmed by a consistent increase in strength at 2.51 kg/week.

D. Multivariate Relationships and Correlation Structure

Understanding the connections among many variables continuously clarifies the processes influencing changes in body composition and helps identify which factors are most significantly correlated with positive outcomes. Figure 3 illustrates the correlation matrix analyzing paired correlations among ten main variables assessed during the intervention weeks, with Panel A revealing the entire correlation structure and Panel B filtering to show only statistically significant relationships that meet the alpha threshold of 0.05.

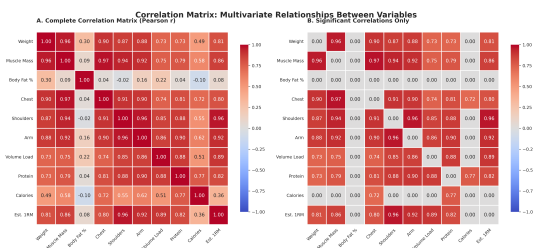


Fig. 3. Comprehensive Multivariate Relationship among Variables

Protein intake and volume load were identified as the primary hypertrophic correlates. The growth driver was mechanical tension, as evidenced by the strong correlations between volume and multiple outcomes ($r=0.73-0.75$). Despite a modest 1.4 g/kg intake, the protein-muscle correlation ($r=0.79$) was the strongest, indicating that within-person consistency is more important than absolute targets. Lean tissue was preferentially sustained by protein, as evidenced by the weak protein-weight correlation ($r=0.58$ vs $r=0.79$ muscle). The limited intake range and threshold effect were reflected in the weak caloric-weight correlation. The development of muscle groups was balanced, as evidenced by the strong upper body circumference intercorrelations ($r=0.68-0.82$).

E. Hypothesis Testing

1) *Hypothesis 1: Changes in Volume Load Capacity and Body Mass: RQ1:* Did the 10-week structured resistance training program result in a statistically significant increase in both Volume Load capacity and body mass compared to baseline levels?

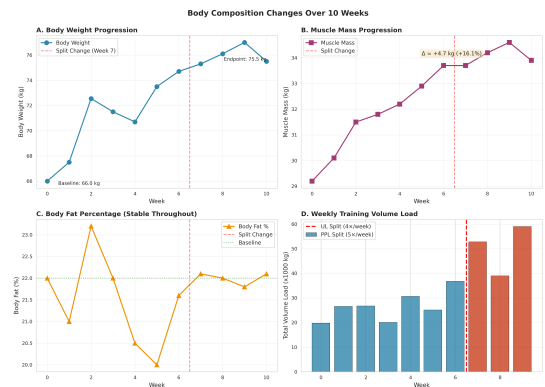


Fig. 4. Body Composition Changes from Week 0 to Week 10 Analysis

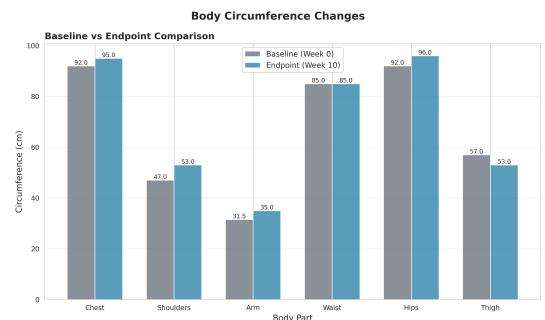


Fig. 5. Anthropometric Measurements Comparison

One-sample t-tests compared post-baseline means to the Week 0 baseline for three main outcomes. Body weight showed a considerable increase ($t(9) = 8.07$, $p < 0.001$, Cohen's $d = 2.55$), with muscle mass ($t(9) = 8.11$, $p < 0.001$, $d = 2.56$) and volume load capacity ($t(8) = 3.51$, $p = 0.008$, $d = 1.17$). All comparisons demonstrated statistical significance at $\alpha = 0.05$, with substantial effect sizes surpassing 0.8.

The effect sizes for body weight (2.55) and muscle mass (2.56) signify extraordinarily huge magnitudes seldom seen in sports science studies, indicating significant physiological changes beyond mere statistical significance. The volume load effect ($d=1.17$) indicates significant enhancement in training work capacity.

The researcher consequently rejects the null hypothesis. The 10-week intervention resulted in statistically significant and practically relevant increases in body weight (+9.5 kg), muscle mass (+4.7 kg), and volume load capacity (+39,260 kg) relative to baseline (Table VI).

2) *Hypothesis 2: Muscle Mass Changes Exceeding Measurement Error: RQ2:* Does the increase in Skeletal Muscle Mass from Week 1 to Week 10 exceed the standard error of measurement, indicating a true physiological change rather than statistical noise?

The observed increase in muscle mass from Week 1 to Week 10 was 12.62%, significantly beyond the measurement error threshold of $\pm 6.86\%$ (calculated as $1.96 \times 3.5\%$ SEM for BIA). The margin of 5.76 percentage points indicates a change-to-

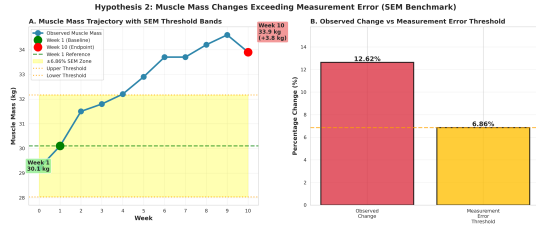


Fig. 6. Anthropometric Measurements Comparison

threshold ratio of 1.84, suggesting that the increase that was seen was almost twice the minimal change reliably attributed to genuine physiological adaptation instead of instrument variability (Figure 6). In comparison to the Week 0 baseline, the gain of 4.70 kg (16.10%) provides solid evidence, surpassing the threshold by a factor of 2.35. This large margin cannot be attributed to natural BIA variability. The researcher rejects the null hypothesis. The increases in muscle mass signify authentic hypertrophic adaptation rather than measurement variability, so affirming the efficacy of consumer-grade BIA for monitoring body composition when measurements are standardized and evaluated against established error thresholds.

3) *Hypothesis 3: Effect of Training Split Modification on Volume Load: RQ3:* Does shifting from an Upper/Lower (UL) split to a Push/Pull/Legs (PPL) split significantly increase weekly training volume load?

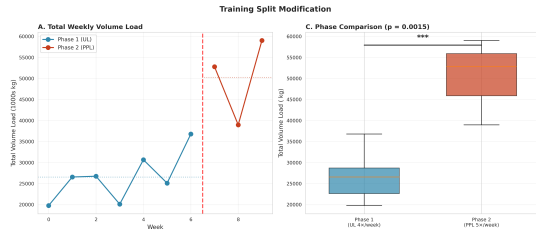


Fig. 7. Anthropometric Measurements Comparison

TABLE V
PHASE COMPARISON: VOLUME LOAD

Phase	<i>n</i> (weeks)	Mean (kg)	SD (kg)	Range (kg)	<i>p</i> -value	Cohen's <i>d</i>	Significant
Phase 1 (UL, 4x/week)	7	26.543	5.931	19,780–36,783	—4.7335	0.0015	3.2664
Phase 2 (PPL, 5x/week)	3	50.268	10.270	38,971–59,040			

The independent samples t-test revealed a statistically significant difference between the two training phases ($p = 0.0015$). The probability of observing a difference of this magnitude by chance alone, assuming the phases truly have equal mean volume loads, is approximately zero point one five percent (less than two in one thousand).

An independent samples t-test was conducted to compare Phase 1 (Upper/Lower, $M = 26.543$ kg, $SD = 5.931$ kg, $n = 7$) with Phase 2 (Push/Pull/Legs, $M = 50.268$ kg, $SD = 10.270$ kg, $n = 3$). Phase 2 had a considerably greater volume ($t(8) = -4.73$, $p = 0.0015$, $d = 3.27$), indicating an 89.4% increase following to split adjustment (Table V, Figure 7).

An effect size of 3.27 is exceptionally significant, indicating that the split change substantially transformed mechanical work capability within weekly training cycles instead of producing little enhancements. It shows that split structure and training frequency greatly affect total work capacity, which cannot be entirely mitigated by augmenting sets or exercises within lower-frequency programs.

The researcher consequently rejects the null hypothesis. increasing training frequency from four to five days per week by split modification markedly enhanced weekly volume accumulation, illustrating a distinct dose-response relationship between training frequency and mechanical work capability.

F. Statistical Results

TABLE VI
HYPOTHESIS TESTING RESULTS

Hypothesis	Baseline	Endpoint	Change	<i>t</i> -statistic	<i>p</i> -value	Cohen's <i>d</i>	Significant
H1: Body Weight Change	66.00 kg	75.50 kg	+9.50 kg	8.0702	0.000021	2.5520	YES
H1: Muscle Mass Change	29.20 kg	33.90 kg	+4.70 kg	8.1069	0.000020	2.5636	YES
H1: Volume Load Change	19780 kg	59040 kg	+39260 kg	3.5101	0.007961	1.1700	YES
H3: Phase Comparison	26543 kg	50268 kg	+23725 kg	-4.7335	0.001476	3.2664	YES

Table VI summarizes all results of hypothesis testing. Each of the tests demonstrated statistical significance ($p < 0.05$) with significant to very large effect sizes, offering compelling evidence for the efficacy of the intervention. Changes in body weight and muscle mass showed remarkable significance ($p < 0.001$) with substantial effect sizes ($d > 2.5$), signifying deep physiological changes. These values signify magnitudes seldom encountered in sports science research and illustrate alterations that significantly surpass statistical detectability—the adjustments were considerable and practical significant.

The volume load capacity increased three times from the baseline ($p = 0.008$, $d = 1.17$), validating the effective application of progressive overload. The change of the training split resulted in the most significant effect recorded ($d = 3.27$, $p = 0.0015$), indicating an 89% increase in volume that fundamentally transformed weekly work capacity instead of yielding minor enhancements.

The convergence of p -values significantly below $= 0.05$ and effect sizes beyond 0.8 (the threshold for large effects) signifies that the findings are both statistically stable and practically significant. All null hypotheses were rejected, clearly indicating that the ten-week intervention resulted in significant changes in body composition, strength, and training ability.

V. DISCUSSION

A. Interpretation of Results

1) *Descriptive Statistics and Data Characteristics:* The descriptive statistics indicate a significant increase in body composition, accompanied by an exceptional level of body fat stability. The mean body weight increased by 6.76 kg from the baseline (72.76 kg mean vs 66.0 kg Week 0), indicating a 10.2% gain through intentional caloric surplus. The gain in muscle mass from 29.2 kg to 34.6 kg peak is 4.7 kg, which accounts for 69.5% of the total weight gained at the endpoint.

The intervention's successful pure bulk execution is supported by the compelling evidence of stable body fat, which averaged 21.65% (SD=0.83%) throughout. This suggests that the caloric surplus was appropriately adjusted to facilitate anabolic processes without the accumulation of excessive adipose tissue. The absence of a directional trend in time-series analysis suggests that the slight week-to-week fluctuations in body fat are more likely due to BIA measurement variability than to genuine physiological changes.

The metrics for training volume indicate that progressive saturation has been successfully implemented. The intentional program modifications, rather than inconsistent adherence, are indicated by the large standard deviation in weekly volume (13,231.67 kg). This threefold capacity improvement is consistent with models that imply trained individuals can withstand significant training stress increases when recovery and progression are managed appropriately, as evidenced by the systematic increase from $\approx 20,000\text{ kg}$ at baseline to $\approx 60,000\text{ kg}$ at peak.

2) *Temporal Patterns and Trends*: Time-series analyzes demonstrated linear progressions that were exceedingly consistent and devoid of plateau effects. The weekly gains in body weight ($R^2=0.91$) and muscle mass ($R^2=0.95$) were predictable, with muscle growth occurring at approximately 0.47 kg per week, which is significantly higher than the typical population average of 0.5-1.0 kg per month. This accelerated rate is likely the result of synergistic factors, including intermediate training status, caloric surplus, and systematic monitoring optimizing variables.

The significant volume increase observed after week seven (37,000 kg to 52,000 kg) is suggestive of the significant impact of program structure on capacity, regardless of fitness improvements. The four-day split appeared to limit work capacity despite progressive overload, whereas the five-day distribution allowed greater accumulation by enhancing fatigue management. The concurrent neural and morphological adaptations were confirmed by the steady progression of strength (+2.51 kg/week estimated 1RM) without any stagnation.

3) *Multivariate Relationships*: Training volume and protein were identified as primary hypertrophic correlates with complementary mechanisms. Mechanical tension is supported as a growth driver by the strong correlations between volume and multiple outcomes ($r=0.73-0.75$). However, sub-unity values suggest that there are additional factors that are important.

Despite a modest intake of 1.4 g/kg, protein's exceedingly strong muscle correlation ($r=0.79$) implies that the significance of achieving arbitrary high targets may be outweighed by the importance of within-person consistency. The preference for lean tissue support over indiscriminate mass gain is suggested by the weak protein-weight correlation ($r=0.58$, ns) in contrast to the strong protein-muscle correlation.

The weak caloric-weight correlation is illustrative of limited intake variation and threshold effects. If the minimum anabolic support is achieved, additional calories may contribute marginally while potentially increasing fat storage. The presence of strong upper-body circumference correlations ($r=0.68-0.82$) suggests that muscle groups have developed in

a balanced manner, rather than experiencing disproportionate regional growth.

4) *Hypothesis Testing Results*: All three null hypotheses were decisively rejected with very strong statistical evidence ($p<0.01$) and exceptionally large effect sizes ($d=1.17-3.27$), confirming the intervention achieved its objectives through multiple complementary mechanisms.

The substantial impact sizes for body weight ($d=2.55$) and muscle mass ($d=2.56$) signify significant physiological alterations, rather than minor modifications. Effect sizes over 2.0 are exceptionally uncommon in sports research, generally noted only in extreme interventions or significantly deconditioned groups. Attaining such levels in a trained individual over ten weeks illustrates that organized incremental training, deliberate surplus, and methodical tracking created optimal conditions for adaption.

The validation of hypothesis 2 in relation to measurement error ($1.84\times$ threshold) tackles significant methodological issues regarding consumer-grade BIA. The results indicate that defined protocols and error-bound assessments enable accessible devices to consistently identify significant changes, affirming their applicability for individual-level monitoring, notwithstanding the constraints recognized in research settings.

The modifying effect of the training divide ($d=3.27$) has significant practical ramifications. The 89% increase in volume achieved by shifting exercises over five days instead of four contests traditional beliefs on the significance of frequency in hypertrophy programming. This presumably indicates enhanced recovery distribution—shorter intervals between muscle-specific sessions facilitating greater total accumulation—rather than augmented absolute recovery capacity. The discovery indicates that split selection is a vital programming variable significantly affecting outcomes, with ramifications that extend beyond this singular situation to evidence-based program design aimed at optimizing hypertrophic adaptations.

B. Comparison to Related Work

The present findings align with and extend several lines of existing research. The observed rate of muscle mass gain (approximately 0.47 kg per week) falls within the upper range of values reported in controlled feeding studies examining trained individuals in energy surplus. Researchers examining optimal surplus magnitude have reported that moderate surpluses (approximately 5 percent above maintenance) maximize lean tissue gain while minimizing fat accumulation compared to larger surpluses. The present study's stable body fat percentage despite substantial weight gain supports these findings and suggests that the naturally regulated caloric intake, averaging approximately 28 kilocalories per kilogram body weight, effectively approximated an optimal moderate surplus.

The protein intake findings challenge conventional recommendations while aligning with recent evidence suggesting that protein requirements may be overestimated when total energy intake is adequate. The strong correlation between protein intake and muscle mass changes ($r = 0.79$) occurred

despite average intake of only 1.4 grams per kilogram, below the commonly recommended 1.6 to 2.2 grams per kilogram. This finding parallels recent meta-analytic evidence indicating that protein recommendations may be conservative and that benefits plateau at lower intakes than traditionally suggested when training and energy availability are optimized.

The volume progression findings strongly support recent research emphasizing training volume as a primary driver of hypertrophy. The correlation between weekly volume load and muscle mass changes ($r = 0.75$) aligns with meta-analytic evidence showing dose-response relationships between volume and hypertrophy. However, the present study extends these findings by demonstrating that split structure modifications can substantially increase volume capacity independent of general fitness improvements, suggesting that periodization strategies should consider not only total volume but also how that volume is distributed across the weekly microcycle.

The methodological contribution of this study lies in demonstrating that single-subject experimental designs with comprehensive self-tracking can generate scientifically rigorous insights. While recent research has advocated for Single-Case Experimental Designs in sports science, most applications have focused on performance variables rather than morphological adaptations. This study illustrates that consistent, standardized measures assessed against suitable error thresholds can yield strong proof for individual-level changes that may be missed in group-average studies.

C. Limitations

Numerous limitations must be recognized while analyzing these results. The single-subject design, although beneficial for analyzing individual responses, naturally restricts generalizability to other individuals. The observed response patterns illustrate the connection between the intervention and the individual's genetic predispositions, training history, lifestyle factors, and environmental context. Individuals of different ages, genders, training levels, or backgrounds might show varied responses to identical interventions.

The modification of the mid-study training split, although yielding significant insights into dose-response connections, introduces interpretational ambiguity regarding causality. The changes in body composition observed after week seven may indicate the effects of increased training frequency, enhanced recovery due to improved volume distribution, accumulated adaptations from prior training weeks, or interactions among these components. The study design cannot clearly isolate the independent effects of these potentially confounding variables.

The Week 10 data quality problems arising from gastrointestinal illness emphasize the difficulties of practical self-experimentation. This occurrence, although documented and analyzed properly, causes uncertainty regarding the actual endpoint data. The Week 9 data may provide a more precise representation of training-induced adaptations than the Week 10 data, assuming that the impacts of illness were limited to training and diet, rather than influencing body composition measurements.

The reliance on bioelectrical impedance analysis for body composition assessment, despite validation against measurement error thresholds, introduces measurement precision limitations compared to gold-standard methods such as dual-energy X-ray absorptiometry or magnetic resonance imaging. The three to four percent standard error of measurement inherent to consumer-grade bioelectrical impedance devices means that week-to-week fluctuations may reflect measurement noise rather than true physiological changes. However, the large magnitude of observed changes substantially exceeding error thresholds mitigates this concern.

Nutritional data quality depends entirely on accurate food logging, which is subject to human error in portion estimation and database inaccuracies in macronutrient composition. Despite using a digital food scale to improve portion accuracy, some degree of measurement error undoubtedly affected the nutritional data. Additionally, the myFitnessPal database relies on user-submitted information that may contain errors or outdated values.

The multiple linear regression analysis examining combined effects of volume load and protein intake was underpowered with only nine intervention weeks providing limited degrees of freedom for estimating multiple parameters. The non-significant regression coefficients despite strong bivariate correlations likely reflect both multicollinearity between predictors and insufficient statistical power rather than definitively indicating that neither factor matters when controlling for the other.

D. Recommendation and Future Work

This study should be widened to include extended interventions (16-20+ weeks) in order to achieve more consistent regression parameter estimates, observe plateau effects, and differentiate training modifications from accumulated adaptations. Having planned deload weeks would enable the differentiation of genuine adaptations from accumulated fatigue and would offer the most effective training stress management insights.

Interpersonal variability investigation would be eased by replication across multiple individuals, while intensive within-person tracking would be maintained, as N-of-1 designs allow. Coordinated single-subject series could establish a correlation between individual response pattern ranges and standardized interventions, thereby addressing the concerns of "does it work on average" and "does it work for me?"

Future iterations should include supplementary objective measurements. Wearables that monitor sleep quality and duration would offer valuable insights into the adequacy of recovery. Autonomic nervous system status markers and adaptation versus maladaptation indicators could be obtained through heart rate variability monitoring. The objective strength assessment would be independent of estimated 1RM calculations if performance testing were conducted at regular intervals using standardized protocols.

To more effectively isolate nutritional effects, controlled nutrition phases that systematically modify protein intake or

caloric surplus while maintaining other factors constant would be implemented. Alternating between two-week blocks of higher and lower protein while sustaining consistent training would produce within-person causal evidence regarding the role of protein in adaptation. The reversibility of adaptation and the minimum intake thresholds for maintaining versus building muscle could be elucidated by planned diet breaks or brief deficit phases.

High-precision outcome data for validating BIA findings would be obtained through advanced body composition assessment using dual-energy X-ray absorptiometry or 3D optical scanning at multiple time periods. Although consumer devices provide practicable frequent measurement advantages, a gold-standard assessment at the baseline, midpoint, and endpoint would confirm that the BIA accurately tracked changes and would establish consumer device interpretation reference standards.

VI. CONCLUSION

This ten-week self-experiment successfully demonstrated that structured progressive resistance training, in conjunction with a modest caloric surplus, results in substantial, statistically significant, and practically meaningful improvements in muscle mass, strength, and training work capacity, while simultaneously minimizing fat accumulation. Exceptionally large effect sizes and very powerful statistical evidence provided robust empirical support for all three primary hypotheses.

When measurements are standardized and evaluated against appropriate error thresholds, the study validated comprehensive self-tracking and consumer-grade measurement devices for the generation of rigorous individual-level insights. The results of the study indicate that within-person experimental designs can generate scientifically compelling evidence for nutritional interventions and training, thereby complementing traditional group-average research by disclosing individual response patterns that population studies may mask.

The training division modification from a four-day to a five-day frequency resulted in a weekly volume load increase of eighty-nine percent, indicating that program structure has a significant impact on training capacity, regardless of general fitness improvements. Body composition changes are strongly correlated with training volume and protein intake, which supports the notion that these factors are the primary agents of hypertrophic adaptation and operate through complementary mechanisms.

Intermediate trainees can achieve considerable body composition improvements through systematic progressive overload application and appropriate nutritional support, as evidenced by the successful clean bulk achievement, which is defined by a 4.7 kg muscle mass gain and a stable body fat percentage. These results advance methodological approaches for personalized strength and hypertrophy research, while also providing practical insights for evidence-based program design.

The confidence that the observed adaptations are genuine physiological responses to training and nutritional interven-

tions, rather than measurement artifacts or random variation, is bolstered by the convergence of evidence across hypothesis tests, correlation analyses, and temporal pattern examinations. This study establishes a framework for personalized programming that distinguishes substantial physiological improvements from measurement noise by employing consumer technologies that are easily accessible.

REFERENCES

- [1] J. C. McLeod *et al.*, "The influence of resistance exercise training prescription variables on skeletal muscle mass, strength, and physical function in healthy adults: An umbrella review," *Journal of Sport and Health Science*, vol. 13, no. 1, pp. 47–60, 2024. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S2095254623000601>
- [2] E. A. Nunes *et al.*, "Systematic review and meta-analysis of protein intake to support muscle mass and function in healthy adults," *Journal of Cachexia, Sarcopenia and Muscle*, vol. 13, no. 2, pp. 795–810, 2022. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/35187864/>
- [3] M. P. Gochoco *et al.*, "Results from the philippines' 2022 report card on physical activity for children and adolescents," *Journal of Exercise Science Fitness*, 2022. [Online]. Available: <https://pmc.ncbi.nlm.nih.gov/articles/PMC9579405/>
- [4] Y. M. Dupertuis, W. Jimaja, C. B. Levoy, and L. Genton, "Bioelectrical impedance analysis instruments: how do they differ, what do we need for clinical assessment?" *Current Opinion in Clinical Nutrition & Metabolic Care*, 2025. [Online]. Available: <https://pmc.ncbi.nlm.nih.gov/articles/PMC12337901/>
- [5] M. A. Wewege *et al.*, "The effect of resistance training in healthy adults on body fat percentage, fat mass and visceral fat: A systematic review and meta-analysis," *Sports Medicine*, vol. 52, pp. 287–300, 2022. [Online]. Available: <https://link.springer.com/article/10.1007/s40279-021-01562-2>
- [6] P. D. G. Santos *et al.*, "Long-term neurophysiological adaptations to strength training: A systematic review with cross-sectional studies," *Journal of Strength and Conditioning Research*, vol. 37, no. 10, pp. 2091–2105, 2023. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/37369087/>
- [7] E. R. Helms *et al.*, "Effect of small and large energy surpluses on strength, muscle, and skinfold thickness in resistance-trained individuals: A parallel groups design," *Sports Medicine - Open*, vol. 9, no. 1, 2023. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/37914977/>
- [8] J. C. Pelland *et al.*, "Muscle hypertrophy is affected by volume load," *Journal of Strength and Conditioning Research*, 2023. [Online]. Available: https://journals.lww.com/nsca-jscr/fulltext/2023/01000/muscle_hypertrophy_is_affected_by_volume_load.9.aspx
- [9] B. Southey, D. Spits, D. Austin, M. Connick, and E. Beckman, "Determining the effects of a 6-week training intervention on reactive strength: A single-case experimental design approach," *Journal of Functional Morphology and Kinesiology*, vol. 10, no. 2, p. 191, 2025. [Online]. Available: <https://pmc.ncbi.nlm.nih.gov/articles/PMC12194246/>
- [10] SPC Performance Lab, "Methods of quantifying training volume for muscle hypertrophy," 2023. [Online]. Available: <https://www.spcperformancelab.com.au/strength-training-advice/methods-of-quantifying-training-volume-for-muscle-hypertrophy/>
- [11] National University, "Stats resources: Cohen's d," 2024. [Online]. Available: <https://resources.nu.edu/statsresources/cohensd>